TP 9172 E

ANNUAL REPORT : CANADIAN COAST GUARD RESEARCH AN
CA1 DTN 90- A56

Annual Report
1989 / 90

Vol. 1 Report

Transport Canada / Transports Canada

PUBLICATION DATA FORM

1. Transport Canada Publication No.	2. Project No.	3. Recipient's Catalogue No.
TP 9172 E/F - Vol. I	-	-

4. Title and Subtitle	5. Publication Date
Canadian Coast Guard Research and Development ANNUAL REPORT 1989/90	March 31, 1991
	6. Performing Organization Document No. TP 9172 E
7. Author(s) S. P. Ball, Executive Services	8. Transport Canada File No. AMEB 2204 9172
9. Performing Organization Name and Address CCG	10. DSS File No.
	11. DSS or Transport Canada Contract No.
12. Sponsoring Agency Name and Address CCG	13. Type of Publication and Period Covered Annual Report 1989/90
	14. Sponsoring Agency Code
15. Supplementary Notes	16. Project Officer S. P. Ball

17. Abstract

Annual Report on 1989/90 CCG R&D Activities

Vol. I - Overview of CCG R&D Program

Library and ... Centre / ... (CSLA)

AUG 26 1991

Transport Canada / Transports Canada

18. Key Words	19. Distribution Statement
Marine Research and Development, Transportation Research	This report is circulated throughout the federal government, provincial departments of transport, industry, and universities having marine schools.

20. Security Classification (of this publication)	21. Security Classification (of this page)	22. Declassification (date)	23. No. of pages	24. Price
Unclassified		N/A		

92-04976/

DISCLAIMER

This report constitutes an accounting for resources by the Marine Group/Canadian Coast Guard of Transport Canada. This report covers the period April 1, 1989 to March 31, 1990 and as such reflects the organization of that period. Due to recent organizational changes, portions of the report may appear in consistent with more current information, but the content is accurate for the chronological period being reported.

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INTRODUCTION

The functional components and associated Crown Corporations of the Marine Group conduct and participate in R&D programs as an integral part of fulfilling their respective missions. In addition, R&D efforts are used to support the interests of other members of the Canadian marine community, to promote maximum Canadian industrial benefits and to meet other federal economic and regional objectives as appropriate.

Coast Guard, with its broad responsibilities for the regulation and certification of commercial vessels and for the provision of safe navigable waterways, conducts the largest R&D program of the Marine Group components.

Various special sources of funds are available to the Marine Group components tc support their R&D programs. The major funding is from within the Marine Group reference level and from special controlled allotments. The remainder is obtained from several interdepartmental R&D programs.

The 1989/90 R&D Annual Report is the third comprehensive annual report of the Marine Group/CCG R&D activities.

The 1989/90 annual R&D report is published in support of our information dissemination and technology transfer policies. It is intended to communicate and share our knowledge and experience and to solicit comments/suggestions from the industry at large.

VOLUME I

Volume I of the report contains an overview of the results of the Coast Guard R&D program for 1989/90.

Section I of Volume I details the objectives and responsibilities of the Marine Group/CCG, and the individual R&D programs under which projects were carried out.

Section II provides highlights of achievements during FY 1989/90, and program expenditure summaries by funding sources and Key Result Areas (KRA'S)/Fleet Program Areas (as appropriate).

Section III indicates future goals. Appendices which include expenditure summaries for individual programs and detailed project information are published as a separate volume.

Section IV contains a list of reports* which resulted from research projects conducted in 1989/90. Some of the reports may have a restricted distribution because of commercial confidentially of the data, international agreements, etc.

* **The list also appears as Appendix H of Volume II.**

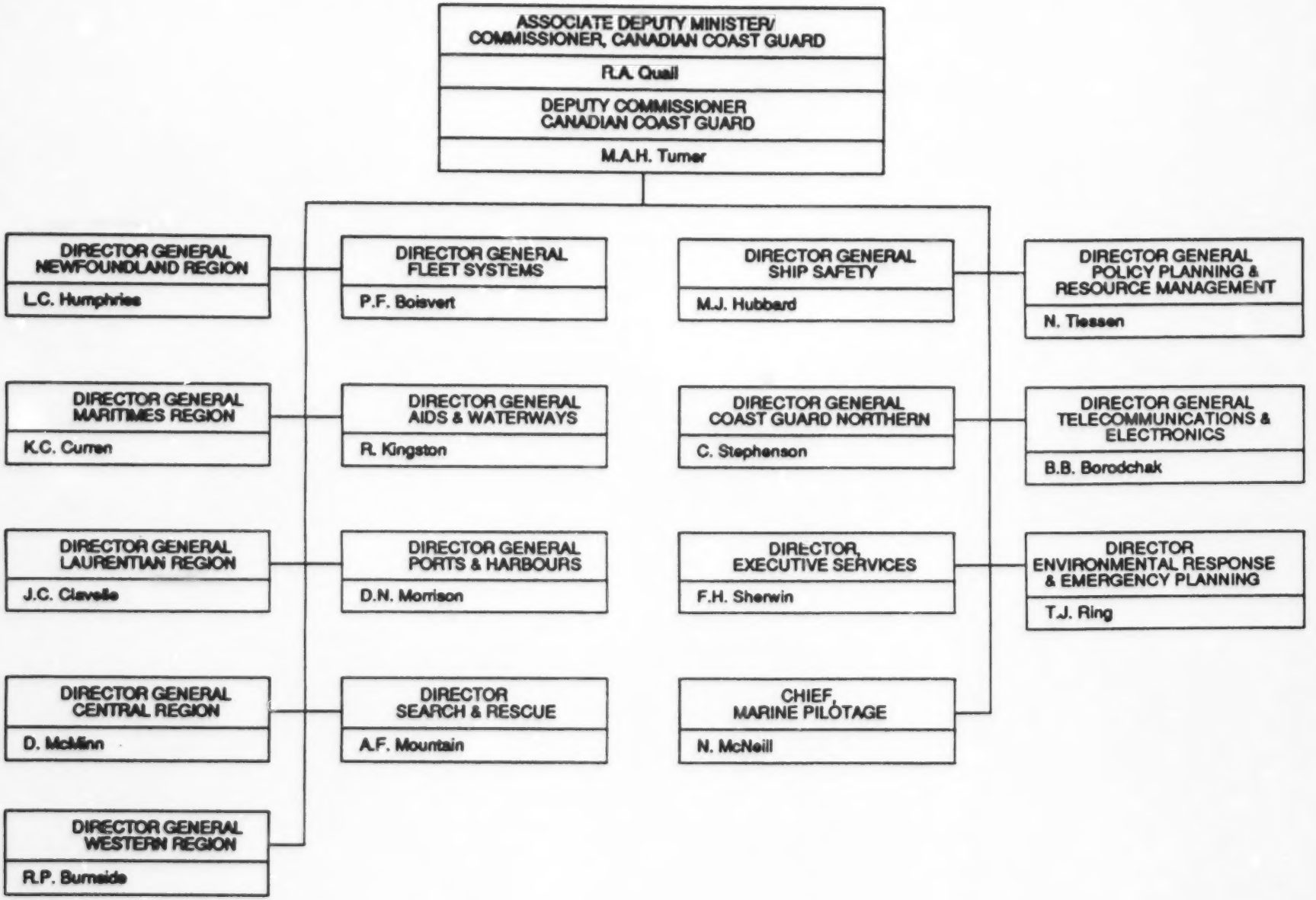
VOLUME II

Volume II of the report contains summaries of each project undertaken as part of the CCG R&D Program.

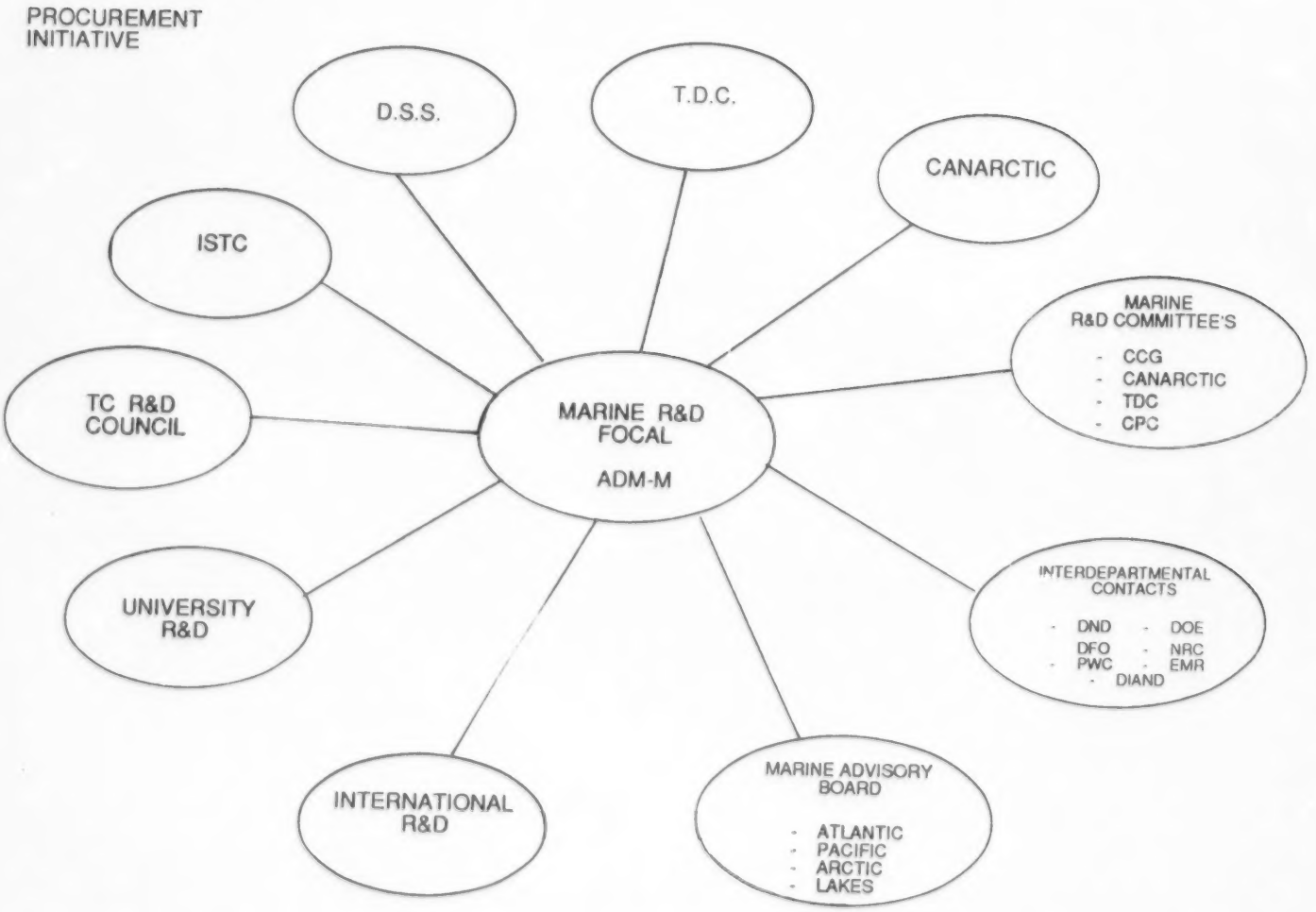
In addition it contains a list of reports* which resulted from research projects undertaken in 1989/90.

* **The list also appears as Section IV of Volume I.**

CANADIAN COAST GUARD ORGANIZATION



R&D COORDINATION (MARINE)



SECTION I

SECTION I

OBJECTIVE OF MARINE/COAST GUARD

To ensure the provision of operational policies and programs for the use of water transportation interests in order to contribute to the safe, efficient and economical conduct of marine activities and to contribute to the protection of the quality of the marine environment in waters under the jurisdiction of the Government of Canada; and, where appropriate, to develop, operate and maintain specific elements of the marine transportation system.

COAST GUARD MISSION STATEMENT

Within the context of the governmental, departmental and Coast Guard objectives, the purpose of the Coast Guard is to provide service to the marine sector.

Coast Guard strives for a safe efficient marine transportation system that includes essential services for the marine industry, including fishing, and for the boating public and the provision of public commercial ports.

KEY ELEMENTS OF COAST GUARD'S SERVICE GOAL

Key elements of the Coast Guard's service goal are:

- Responsiveness to the people we serve and to the marine environment in which we work.
- Optimum use of resources.
- Supporting environmentally sound practices.
- Commitment to our people.
- Doing the right things, doing them well, working as a team.

In order to achieve the goal, the Coast Guard seeks commitment from its people and supports their participation.

MARINE R&D OBJECTIVES

To undertake R&D in support of Marine Group/CCG operational, regulatory, and procurement objectives.

To contribute to related federal objectives and provide the leadership necessary to ensure that marine transportation R&D activities are coordinated.

(cont'd) ...

To promote and facilitate timely technological innovation in marine transportation and related (marine) industries, contributing to improved safety, efficiency and effectiveness in the marine transportation system.

To work with other federal research centres, provinces, universities and independent research agents to promote marine centres of excellence and to aid in the training of operating personnel, scientists and other professionals in marine matters.

ENVIRONMENTAL OBJECTIVES

The Canadian Coast Guard strives to facilitate the introduction of new technology for tracking and detection, clean-ups, the effects of ships source pollution and spills.

Marine research aimed at improving regulations has some, if not total environmental significance. The safety of the environment and persons has always been a critical priority.

To ensure that all marine pollution issues are reviewed and where appropriate, co-operative remedial action is taken to address them.

PARTICIPATING COAST GUARD BRANCHES AND BRANCH R&D OBJECTIVES

Executive Services:

To provide administrative and coordination services in R&D to other participating branches. To provide liaison with the marine community at large and with specific marine R&D performers.

Fleet Systems:

To improve the operational efficiency of the CCG fleet by developing and examining new technology as well as by collecting data to evaluate operational effectiveness. To acquire and maintain an effective and efficient fleet.

Aids and Waterways:

To ensure that utilization of Canadian waterways and way facilities is not detrimental to public safety, property, or the marine environment.

To increase accessibility of Canadian ice-covered waterways to marine environment.

To foster increased efficiency of the aids operation by reducing operational and maintenance costs.

(cont'd) ...

Ship Safety:

To obtain necessary data for keeping ship safety regulations up-to-date with development in modern technology and for drafting new regulations as necessary.

Telecommunications and Electronics:

To assess the suitability of available telecommunications, electronics, computer and space technology to meet Coast Guard operational and regulatory requirements and those of the marine community.

To assess newly developed systems or equipment, to accomplish necessary pre-engineering, and to monitor and support fundamental technological investigations in electronic circuitry performed by the scientific community and by industry.

Emergencies Branch:

To be proactive in sponsoring the development of state-of-the-art pollution clean-up technologies, rather than relying on existing technology. To sponsor related practical field evaluation work to improve CCG marine emergency response capability. To promote the development of practical projects and sponsor field trials of equipment.

Northern:

To obtain necessary data specific to icebreaking ships operating in the Arctic, in order to keep ship safety regulations up to date. To propose new regulations for developing Arctic technologies.

To continue polar icebreaker R&D related to ship design, its subsystems and basing requirements.

Search and Rescue:

To improve marine operational efficiency in search and rescue activity through the field evaluation of newly developed equipment.

CCG FUNDING SOURCES

Arctic Waters Regulatory Studies Program (AWRSP):

This program was set up in 1986/87 due to the cancellation of the Arctic Marine Transportation R&D Program (AMTRD). The main program objective is to update the Arctic Waters Pollution Prevention Act. Therefore, priority is given to projects addressing regulatory and safety concerns in the Canadian Arctic. Project details can be found under **Appendix A.**

Fleet Capital Investment Plan (FCIP) R&D:

Treasury Board approval for the R&D component of FCIP was obtained in 1985/86; the program commenced in 1986/87. This component is defined as any investigatory, analytical or developmental activity, whether associated with equipment, systems, or personnel that is designated to improve the efficiency or effectiveness of the Fleet Mission. Project details can be found under **Appendix C.**

Regulatory and Engineering Studies (RD&ES) Plan:

The RD&ES Plan was established in 1982/83 to fund feasibility and engineering studies, field service surveys or other such types of applied R&D related projects. Project details are under **Appendix E.**

Energy R&D Program (ER&D):

The federal Energy Research and Development Program began in 1974 under the administration of the Department of Energy, Mines and Resources (Office of Energy R&D). The Panel Process was initiated in 1975 with the establishment of the Panel and OERD. It subsequently underwent two modifications, the first in 1981 when the budget was substantially increased and the second in 1985 when the budget was substantially decreased.

The Program is divided into seven TASKS:

1) Energy Efficiency
2) Coal
3) Fusion
4) Renewable Energy and Generic Environment
5) Alternate Transportation Fuels
6) Oil, Gas and Electricty
7) Co-ordination and International Co-operation

In the marine mode sub-program, the principle ER&D activities have historically been concerned with the transport of energy commodities in particular with the transport of oil and gas from the Arctic and offshore regions. As a result, the Oil, Gas and Electricity (TASK 6) is the most frequent source of funds for the Marine Group/CCG.

(cont'd) ...

The Energy Conservation (TASK 1), the Renewable Energy and Generic Environment (TASK 4) and Atlernate Transportation Fuels (TASK 5) are also potential sources of funds for Marine Group components. Project details can be found under **Appendix D.**

DSS Unsolicited Proposals (UPs) Program:

The original DSS UP Program was created to encourage both government departments and private industry in active participation and promotion of R&D, especially R&D related to the generation of economic wealth in Canada. Although, this program was cancelled on May 15, 1989, current federal policy still promotes more industry involvement in R&D and to use its R&D support to achieve a range of federal mission and developmental objectives.

Proposals supported by the Marine Group are financed from the CCG internal R&D programs. Proposals funded or sponsored in 1989/90 are listed in **Appendix F.**

Transport Development Centre (TDC) "A" Base R&D Program:

The mission of the Transportation Development Centre (TDC) is to provide components of Transport Canada with specific data, research and demonstration projects to assist components in their operational, regulatory, policy, planning and evaluation functions, and to undertake exploratory R&D addressing requirements in transportation technology and systems that are high risk, long range and national in scope.

Marine Group components may participate jointly with TDC in the management of R&D projects or may ask TDC to undertake projects on their behalf. Projects undertaken jointly with TDC are included under **Appendix A and C.**

Other Departments:

Every year there are some projects which are jointly funded by several departments. Either Coast Guard supports a project initiated by other departments or we get support for our projects. This occurs when the project results are of direct or indirect benefit to a number of government departments or agencies. Projects are included under **Appendix A, C** and **D.**

SECTION II

1989/90 Program Highlights

SECTION II

1989/90 PROGRAM HIGHLIGHTS

ARCTIC WATER REGULATORY STUDIES PROGRAM (AWRSP):

In 1989/90, extensive work was undertaken using the R&D process to identify and define a number of requirements and issues related to CG Northern marine operations. Projects included studies related to environmental evaluation, and navigational and communications capabilities in the north, as well as a program review and analysis of the organizational requirements to fulfill the mandate of the Northern Operations Division.

Much of the R&D work undertaken was connected with the POLAR 8 project and was required in order to establish or determine the standards, requirements and external support needs of POLAR 8. The POLAR 8 project was canceled in February, 1990 and, although this project provided a strong impetus to initiate these studies, long term regulatory requirements in support of safe and environmental sound marine activity in the north will dictate the continuation of this type of R&D.

FLEET CAPITAL INVESTMENT PLAN (FCIP) R&D:

The development of VARMINT, a vibration analysis software package which uses artificial intelligence, progressed during 1989/90.

Full scale trials carried out on the BERNIER bow modification project resulted in acquisition of data on performance in both open water and level ice conditions for the ship in its actual operating configuration.

Icebreaking Strakes project is a continuation of the mathematical modeling of icebreaking prediction and performance assessment of Carter mode.

Consideration is now being given to the Analytical Propeller/Ice Interaction Model propeller analysis package being integrated with a shaft modeling tool.

A literature review on the effect of porosity on the mechanical properties of welds has been performed.

RESEARCH & DEVELOPMENT AND ENGINEERING STUDIES PLAN (RD&ES):

Numerous projects intended to improve the safety, efficiency and effectiveness of marine transportation were undertaken under the plan.

Among the subjects investigated were various means to improve the efficiency of the marine aids operation by reducing equipment maintenance/servicing requirements and improving equipment reliability.

(cont'd) ...

Engineering modifications of Heavy Oil Skimmer were designed and built. Test and trials were carried out March 1990.

Ship Safety was busy developing unique software applicable to Canadian ship design and stability, researching fishing vessel stability and developing standards for compliance with SOLAS designs for child lifejacket.

PROGRAM FOR ENERGY RESEARCH AND DEVELOPMENT:

1988/89 saw movement towards the development of SINSS manning and training manual.

Both local and international projects on ice loads, hull structure, ship interaction with actual ice conditions has resulted in major advancements.

The Beaufort Sea study highlighted the potential feasibility of year-round trafficiability of deep-draft tankers along the southern route.

The study of ice regime conditions in the Eastern Parry Channel continues. A vector plotting aid software package has been developed to improve analysis efficiency and accuracy of SAR data suites. Also a hard copy SAR production system was established to produce full resolution hard copy prints of SAR digital data.

SECTION III

SECTION III

FUTURE GOALS:

The Coast Guard research program constitutes a major expenditure in marine transportation research. Its impact extends beyond the immediate objectives of this federal agency. The results are of value to scientists, industry and universities.

A major objective of the CCG is to improve the flow of information on its research results to the marine community at large. This involves the development of policies for the control of sensitive information and the promotion of a more focused information dissemination (or technology transfer) procedure.

1989/90 saw the continuance of the effect to improve the CCG R&D planning process. A longer-term horizon on the operating environment and a five-year specification of direction will assist in promoting continuity in research interests in the face of fluctuating resources.

Also, to improve the planning of federal operational and regulatory research, it is important to improve our communication linkages with industry and the science community. National mechanisms such as the ADVISORY BOARD ON MARINE TRANSPORTATION R&D, and the NATIONAL RESEARCH COUNCIL will continue to play a major role in the review of the CCG R&D program.

The effective solicitation of technologies or knowledge from other countries can also be aided through a well-structured program of international co-operation. The involvement of Canadian industries, consulting firms or universities as performers of the Canadian-side of international research will assist the in-flow of technology and foster joint-venture projects.

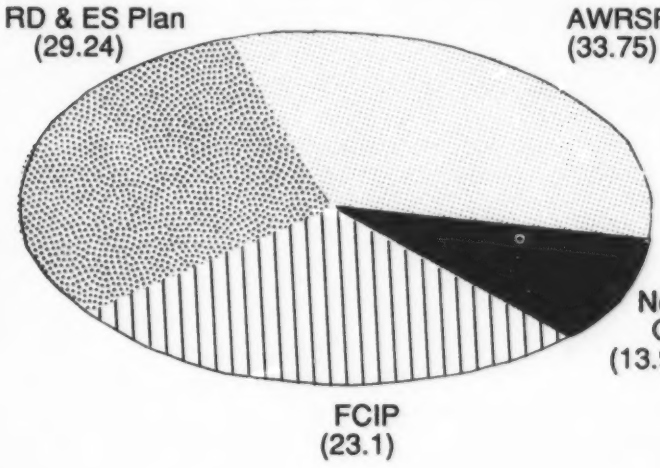
CCG 1989/90 R&D SUMMARY

BY FUNDING SOURCE

FUNDING SOURCE	1989/90 $'000
INTERNAL CCG FUNDING SOURCES	
Arctic Waters Regulatory Studies Program (AWRSP)	1,310
Northern R&D Operations	540
Fleet Capital Investment Plan R&D (FCIP R&D)	897
Research & Development and Engineering Studies (RD&ES) Plan	1,135
TOTAL INTERNAL	3,882
EXTERNAL FUNDING SOURCES	
Energy R&D (PERD)	1,132
DSS's Contribution Proposals (UP's) Program	125
Other Departments (including TDC)	1,000
TOTAL EXTERNAL	2,257
TOTAL	6,139

CCG 1989/90 R&D PROGRAM SUMMARY BY FUNDING SOURCE

INTERNAL FUNDING SOURCES



Arctic Waters Regulatory Studies Program (AWRSP) $1,310K

Northern R&D Operations $ 540K

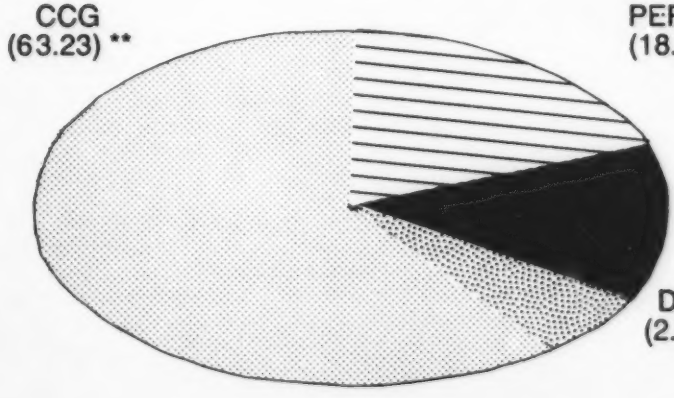
Fleet Capital Investment Plan R&D (FCIP R&D) $ 897K

Research & Development and Engineering Studies Plan (RD&ES) Plan) $1,135K

* **Percentages are based on $3,882K**

Total: $3,882K

TOTAL FUNDING (INTERNAL AND EXTERNAL)



Coast Guard $3,882K

Energy R&D (PERD) $1,132K

Other Departments (including TDC) $1,000K

DSS UP Program $ 125K

** **Percentages are based on $6,139K**

Total: $6,139K

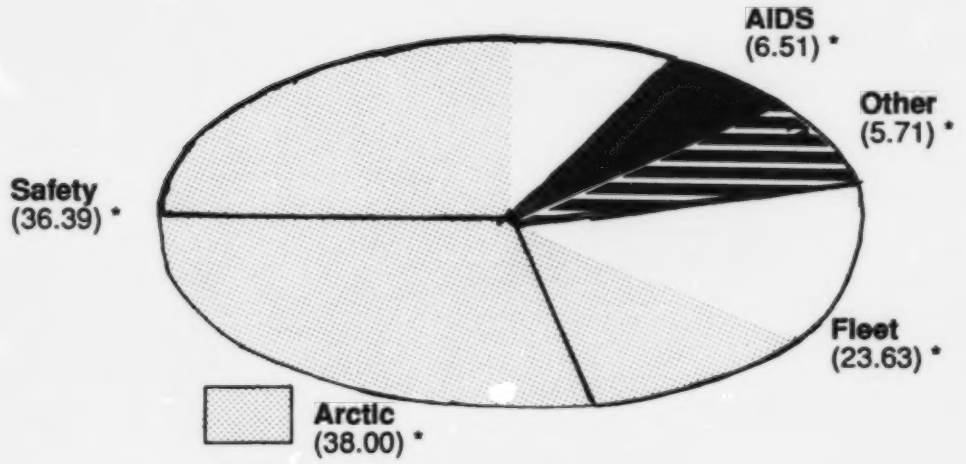
1989/90 CCG R&D PROGRAM - KEY RESULT AREA/SOURCE OF FUNDS

KEY RESULT AREA	AWRSP 000's	FCIP 000's	RD&ES 000's	PERD 000's	DSS UP 000's	OTHER 000's *	TOTAL
Arctic R&D Safety & Regulatory	1,310	-	-	347	7	505	2,169
Northern R&D Operations	540	-	-	-	-	-	540
Fleet: Ships	-	897	-	-	118	436	1,451
Fleet: Aviation	-	-	-	-	-	-	-
Direction & Administration	-	-	30	-	-	-	30
Emergencies	-	-	35	-	-	-	35
Long Range Aid to Navigation	-	-	7	-	-	-	7
Safety & Public Correspondence Communications	-	-	54	-	-	-	54
Search & Rescue Operations	-	-	96	-	-	-	96
Ship Safety	-	-	330	-	-	59	389
Short Range Aids to Navigation	-	-	393	-	-	-	393
Vessel Traffic Services (VTS)	-	-	48	-	-	-	48
Waterways Development Maintemance & Protection	-	-	142	-	-	-	142
Ice Regime Studies (Canarctic Shipping)	-	-	-	785	-	-	785
TOTAL	**1,850**	**897**	**1,135**	**1,132**	**125**	**1,000**	**6,139**

NOTE: Figures Denote Actual Dollar Expenditures

*** TDC and OTHER DEPARTMENTS/INDUSTRY**

1989/90 RESEARCH & DEVELOPMENT PROGRAM BY CCG THRUST AREA



* **Figures based on total funds of $6,139K**

SAFETY - includes R&D related to Ship Safety, Safety and Public Correspondence Communications Arctic Safety and Regulations, and Northern R&D Operations ($2,234K).

AIDS TO NAVIGATION - includes R&D related to Short Range Aids to Navigation, Long Range Aids to Navigation ($400K).

FLEET OPERATIONS - includes R&D which specifically addresses the requirements of Fleet Systems Branch related to either ships or aviation ($1,451K).

OTHER - includes R&D related to Emergencies, Search and Rescue Operations, Waterways Development, Maintenance and Protection, Vessel Traffic Services and Direction and Administration ($351K).

ARCTIC - overlaps the headings above and includes mainly Arctic Safety and Regulatory Research ($1,310K), Northern R&D Operations ($540K) and the Arctic portion of Fleet Operations ($4830K) (Total $2,333K)

SECTION IV

SUMMARY OF PROJECT REPORTS

ARCTIC WATERS REGULATORY STUDIES PROGRAM
ARCTIC RESEARCH & DEVELOPMENT - SAFETY & REGULATORY

PROJET	TP No.	TITLE
No. 2045	TP 10408E	Analyses of a Design Temperature Database for Arctic Shipping. Reltec Advisory Services Inc., March 1990.
No. 2082		Ice Crushing Indentation.
No. 2089	TP 10435	• Comparative Assessment of the Structural Design Criteria for Arctic Ships.
TP 99812		• Proposals for the Revision of the Arctic Shipping Pollution Prevention Regulations.
	TP 10434	• Implementation of ASPPR Materials Requirements. Reltec Advisory Services Inc., March 1990.
No. 2139	TP 10224	Arctic Winter Marine Ice Atlas - 1989/89 Data Report. Canarctic Shipping Co. Ltd., March 1989.
No. 2299		Swedish Icebreaker 'ODEN' Arctic Trials. P. Grandy and J. McCallum, 1989.

NORTHERN OPERATIONS RESEARCH & DEVELOPMENT

PROJET	TP No.	TITLE
No. 2370		Arctic Communications Facilities Study.
No. 2371		Summary of the Initial Environmental Evaluation of the Polar 8, Canadian Coast Guard, 1990.

FLEET CAPITAL INVESTMENT PLAN (SLIPS)

PROJET	TP No.	TITLE
No. 2915	TP 10048E	Work Scheduling on Canadian Coast Guard Ships Physiological and Psychological Impacts. Le groupe interdisciplinaire de recherche sur l'organisation la santé et la sécurité du travail (GIROSST), Université Laval, September 1989.

(cont'd) ...

FLEET CAPITAL INVESTMENT PLAN (SLIPS) (cont'd) ...

PROJET	TP No.	TITLE
No. 2952	TP 9710	Study of the Effect of Welding Process and Parameters on Weldability of Selected Primers and, by literature review, the Effect of Primer Induced Porosity on Joint Performance. Materials Technology Centre, May 1989.
No. 2975	TP 9709	Field Assessment of Weld Corrosion on the M.V. Arctic. Centre for Frontier Engineering Research, March 1989.

RESEARCH AND DEVELOPMENT AND ENGINEERING STUDIES PLAN DIRECTION & ADMINISTRATION

A Program and Issue Summary - Arctic Marine Transportation R&D Workshop. November 1989, SYPHER: MEULLER International Inc., Ottawa, Canada.

CHARTING OUR COURSE: Speeches and Discussion, Arctic Marine Transportation R&D Workshop, February 1990, SYPHER: MEULLER International Inc., March 1990, Ottawa, Canada.

CHARTING OUR COURSE: REPORT. Arctic Marine Transportation R&D Workshop, February 1990, SYPHER: MEULLER International Inc., March 1990, Ottawa, Canada.

ARCTIC 2000: A PARTNERSHIP IN PROGRESS, Arctic Marine Transportation R&D Workshop, February 1990. Marine Advisory Board, D. Maxwell, P. Preville, July 1990, Ottawa, Canada.

EMERGENCIES

PROJET	TP No.	TITLE
No. 2112		Testing of Modification To The Canadian Coast Guard "Heavy Oil Skimmer". S.L. ROSS Environmental Research Limited, Ottawa, Ontario, March 1990.

(cont'd) ...

SHIP SAFETY

PROJET	TP No.	TITLE
No. 2181		Institute Report IR-1989-05, Investigation into Physics of Ship Capsizing by Combined Captive and Free Running Model Tests Research Report RR-HYD-08, A Time Domain Simulation of Ship Motions in Waves Test Report TR-1989-06, Roll Damping and Drift Force Test on Inshore Fishing Vessel Model M363 Test Report TR-HYD-31, Fishing Vessel Capsizing Model Tests: Preliminary Analysis of Results, Volumes 1-31 Contractor Report CR-HYD-01, Fishing Vessel Capsizing Model Tests: Time Domain Analysis, Volumes 1-17
No. 2205		• Inventory of Reception Facilities for Marine, Wastes In Canada Phase II. Acres International Limited, February 1990. • Directory of Reception Facilities for Marine Wastes In Canada. Acres International Limited, March 1990.
No. 2256	PROTECTED	Assessment of Impact of Proposed IMO Dry Cargo Vessel Subdivision Rules When Applied to Canadian Vessels. Robert Allan Limited, April 1990.

SHORT RANGE AIDS TO NAVIGATION

PROJET	TP No.	TITLE
No. 2321		Test & Evaluation Frequency Agile Radar Transponders (RACONS). DG-TE-147, Volume I, Canadian Coast Guard, June 1990, Ottawa, Canada.

PERD

PROJET	TP No.	TITLE
		Year-Round Accessibility of the Beaufort Sea from the East via the Southern Route of the North-West Passage - Phase II: Validation of Winter Ice Conditions (Volume 1: Main Report; Volume 2: Appendices) Norland Science & Engineering Limited, and Canarctic Shipping Co., March 31, 1990, Ottawa, Ontario.